

REMARKS

In the Non-Final Office Action mailed March 17, 2009, claims 1-25 were pending, claims 1-14, 21, 24 and 25 were withdrawn from consideration and claims 15-20, 22 and 23 were rejected. Claims 1-14 and 24-25 are cancelled in this response, claims 15 and 23 are amended and new claims 26-41 are added. In view of the following remarks, reconsideration and allowance of the present application are respectfully requested.

Of the claims rejected in the outstanding action, the single independent claim is claim 15. Claim 15 is rejected in the outstanding Office Action under 35 U.S.C. 102(b) as being anticipated by Illner, U.S. Patent No. 5,709,672 (hereafter "Illner") and as being anticipated by Shanbrom, U.S. Patent No. 6,361,786 (hereafter "Shanbrom"). Applicants respectfully submit that these rejections are overcome by the present response.

It is well established that "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Applicants submit that claim 15, as amended, is not anticipated by either reference. Set forth below are remarks relating to each of the cited references.

Novelty of Independent Claim 15 Over Illner

Independent claim 15 is directed to a method for manufacturing polymeric material for a medical device that includes, among other elements, "contacting the polymeric material with a liquid composition comprising an organic dye and a reducing agent for a time sufficient to impregnate the polymeric material with the organic dye."

With regard to Illner, the Office Action asserts that:

ILLNER teaches a method of manufacturing polymeric material for a medical device comprising treating the device with gentian violet (i.e. organic dye) and/or silver nitrate (i.e. reducing agent) in an aqueous solution or alcohol solution for a time sufficient to impregnate the solution to the device then remove the device, rinse it and allow it to dry. See e.g. claims 6-10, col. 5 line 63 to col. 6 line 15 and col. 5 lines 38-39. (Office Action, page 4).

It is apparent from the above excerpt of the Office Action that silver nitrate is interpreted in the Action as a reducing agent; however, Applicant submits that silver

nitrate is not a reducing agent, but rather is in fact an oxidizing agent. Attached hereto as Exhibits A and B are print-outs of two records obtained from the on-line resource Wikipedia. Exhibit A is a print-out of the Wikipedia entry for silver nitrate. Applicant would draw the Examiner's attention to the legend at the right side of page 1 of Exhibit A and, in particular to the following symbol that appears near the bottom of page 1:



This symbol is identified as the "NFPA 704" symbol for silver nitrate. An explanation of "NFPA 704" symbols is provided in Exhibit B, which is the Wikipedia entry for NFPA 704. As described in Exhibit B, "NFPA 704 is a standard maintained by the U.S.-based National Fire Protection Association. It defines the colloquial 'fire diamond' used by emergency personnel to quickly and easily determine what, if any, specialty equipment should be used, procedures followed, or precautions taken during the first moments of an emergency response."

The upper quadrant of the NFPA 704 symbol has a background in the color red, the left quadrant of the NFPA 704 symbol has a background in the color blue, the right quadrant of the NFPA 704 symbol has a background in the color yellow and the lower quadrant of the NFPA 704 symbol has a background in the color white. Exhibit B provides additional information regarding the information that is provided in each of the four quadrants of the NFPA 704 symbol. As seen above, and in Exhibit A, the lower quadrant of the NFPA 704 symbol for the compound silver nitrate includes the letters "OX." With reference to page 2 of Exhibit B, it is seen that the letters "OX" or "OXY" in this quadrant indicate that a compound is an "oxidizer."

In view of the above, Applicants submit that silver nitrate is not a reducing agent, as suggested in the outstanding Action, but is rather an oxidizer, or oxidizing agent. As such, Applicants submit that the disclosure of silver nitrate in the Illner reference does not constitute disclosure of a reducing agent as recited in claim 15, and that claim 15 therefore recites subject matter that is novel over Illner.

Novelty of Independent Claim 15 Over Shanbrom

As discussed above, independent claim 15 is directed to a method for manufacturing polymeric material for a medical device that includes, among other elements, “contacting the polymeric material with a liquid composition comprising an organic dye and a reducing agent for a time sufficient to impregnate the polymeric material with the organic dye.” In addition, claim 15 is amended above to specify that, “the impregnated polymer is effective to release the organic dye into a tissue or fluid that contacts the impregnated polymer.” Support for this amendment is found, for example, at page 10, lines 22-23, of the present specification.

As described in the present specification, the impregnated polymer made in accordance with the method of claim 15 can be included in a medical device that is contacted with a patient’s tissue or implanted into a patient. The impregnated polymer is operable to release the organic dye into the device’s environment as it contacts the patient’s tissue or resides in an implanted position over a period of time. By release of the organic dye over time, the impregnated polymer imparts an antibacterial property to a medical device of which it is a part. As stated in the present specification, “Because of the large store of organic dye within the polymer, the polymer...releases organic dye into surrounding biofilm and tissues, killing bacteria in the vicinity of the surface of the medical device.” (Specification, page 6, lines 17-20).

In contrast, the goal of Shanbrom is to provide a polymer material that does not release an organic dye into a surrounding medium. As stated in its Abstract, Shanbrom relates to the treatment of a polymeric material in a manner whereby “devices constructed of these polymeric materials release no free dye to an aqueous solution.” Furthermore, the problem addressed by the disclosure of Shanbrom, as stated at column 1, lines 49-51, of Shanbrom, is the need for “an agent that kills or inhibits microbial growth and adherence which remains adsorbed to the polymeric material under various physiological conditions.”

In view of the above, Applicant’s submit that the polymeric materials produced as described in Shanbrom are not the same as the polymeric materials made in accordance with the method of claim 15, which recites that “the impregnated polymer is effective to release the organic dye into a tissue or fluid that contacts the impregnated polymer.” As such, Shanbrom fails to anticipate the method recited in claim 15.

In addition to the above, it appears that the Office Action interprets the term “reducing agent” recited in claim 15 in an unintended manner and, indeed, a manner that is inconsistent with the specification. In this regard, the Office Action bases its suggestion that the Shanbrom reference discloses the use of a reducing agent on the assertion that “any number of the dyes are reducing agents, see e.g. col. 2 lines 47-50.” (Office Action, page 4). This portion of the Shanbrom specification, however, merely states that “many of the dyes have oxidation-reduction (redox) potentials in the range of many electron transport components of oxidative metabolism” and “it seems possible that such dyes may operate by ‘short circuiting’ electron transport pathways.” Applicants submit, however, that a compound having “oxidation-reduction (redox) potentials in the range of many electron transport components of oxidative metabolism” is not the same as a reducing agent as recited in claim 15.

All chemical reactions in which atoms have their oxidation number (oxidation state) changed are oxidation-reduction (i.e., redox) reactions, and the species involved in the reaction that donates one or more electrons (i.e., becomes oxidized) is referred to as the reducing agent, while the species that accepts one or more electrons (i.e., becomes reduced) is referred to as the oxidizing agent. Stated alternatively, a reducing agent is the element or compound in a redox reaction that reduces another species, i.e., is an electron donor in the system. Thus, the determination of whether a compound is a reducing agent in a given system requires consideration of the other compounds in the system. Furthermore, any compound can be put in an environment in which it acts as a reducing agent (i.e., when in the presence of another species that has a higher reduction potential); however, that compound is not a reducing agent in a different environment (i.e., one in which another species has a lower reduction potential).

With the above background in mind, a person of ordinary skill in the art would understand that the term reducing agent in claim 15 refers to a compound that has a lower reduction potential than the organic dye with which it is mixed prior to being contacted with the polymeric material, i.e. is operable to reduce the organic dye. As such, it would be incongruous to assert that an organic dye is a reducing agent merely because many organic dyes “have oxidation-reduction (redox) potentials in the range of many electron transport components of oxidative metabolism” as suggested in the Action. Therefore, Applicants submit that Shanbrom in fact does not teach or disclose a method as set forth in claim 15, as amended, in which a polymeric material is contacted

with a liquid composition comprising an organic dye and a reducing agent. Applicants therefore submit that the subject matter of claim 15, as amended, is also novel over the disclosure of Shanbrom.

Because the features of claim 15 are not found in Illner or Shanbrom, Applicants submit that independent claim 15, as amended, is novel over Illner and Shanbrom. Applicants therefore respectfully requests withdrawal of the rejection of independent claim 15 under 35 U.S.C. 102(b).

Patentability of Dependent Claims 16-20, 22 and 23

Claims 16-20, 22 and 23 depend, either directly or indirectly, from independent claim 15. Applicants submit that these dependent claims recite patentable subject matter for at least the same reasons that the subject matter of independent claim 15 is patentable, as discussed above. Accordingly, Applicants respectfully request withdrawal of the rejections of dependent claims 16-20, 22 and 23 under 35 U.S.C. §§ 102(b) and/or 103(a).

In addition, Applicants submit that additional reasons support the patentability of the dependent claims. For example, as noted above, claim 23 is amended in this response and, as amended, recites, "The method of claim 15 wherein the reducing agent is selected from the group consisting of: ascorbic acid, ferrous gluconate and mixtures thereof." Applicant submits that neither Illner nor Shanbrom, nor any other reference of record, discloses or suggests this combination, and that the subject matter of this claim is therefore novel and nonobvious over the cited references. As such, Applicants respectfully requests an indication that the dependent claims are allowable as well.

Withdrawn Claims

Claim 21 was previously withdrawn from consideration on the grounds that it is drawn to a nonelected species and that there is no allowable generic or linking claim. Applicants respectfully request that claim 21 be reinstated and allowed on the basis that independent claim 15 is allowable.

Claims 1-14 and 24-25 that were previously withdrawn from consideration as being drawn to non-elected species have been cancelled.

Nonstatutory Obviousness-type Double Patenting

In the outstanding Office Action, claims 15, 18, 19, 20, 22 and 23 are provisionally rejected on the grounds of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-49 of copending Application No. 11/801,616. Since the double patenting rejection is provisional, the Applicant is currently not required to respond to the same. Applicant desires to defer its response to these rejections until the indication of otherwise allowable subject matter in this application.

New Claims 26-41

Of new claims 26-41, the only independent claim is new claim 35. As new claim 35 distinguishes the cited Illner and Shanbrom references for the same reasons set forth above in connection with claim 15, Applicants submit that new claim 35 is likewise in condition for allowance. New claims 26-34 depend from independent claim 15 and new claims 36-41 depend from independent claim 35. Applicants submit that these dependent claims recite patentable subject matter for at least the same reasons that the subject matter of independent claims 15 and 35 is patentable, as discussed above.

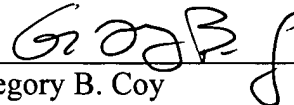
Miscellaneous

In addition to the above, it is stated in the outstanding Action at page 3 that certain claims in the present application are not entitled to a claim of priority to prior-filed Provisional Patent Application No. 60/364,335. More specifically, the Action states that, "The prior application fails to provide support for immersing the polymeric material in the liquid composition for a time selected to be between about one minute and about 24 hours and between about 60 minutes and about 240 minutes in claims 16 and 17. These claims are given a priority date of 3/14/2003." Because the Action makes no rejections that are impacted by the priority claim in the present application, Applicants submit that this issue is moot in the context of the present response, and this statement is taken as mere dicta. It is noted for the record, however, that Applicants do not acquiesce in this assertion, and reserve the right to establish that these claims are entitled to the benefit of a priority claim to the prior-filed application if any rejection is asserted in this or any continuing application that is impacted by the priority claim.

CLOSING

Reconsideration of the present application in view of the foregoing amendments and remarks is respectfully requested. Allowance of the pending claims is hereby solicited. The examiner is encouraged to contact the undersigned to resolve any outstanding issues with respect to the present application.

Respectfully submitted,

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Silver nitrate

EXHIBIT A

From Wikipedia, the free encyclopedia

Silver nitrate, also known as **lunar caustic**, is a soluble chemical compound with chemical formula AgNO_3 . This compound is a versatile precursor to many other silver compounds, such as those used in photography. Comparatively, it is far less sensitive to light than the halides. It is called lunar caustic because silver was called luna by the ancient alchemists.^[1]

In solid silver nitrate, the silver ions are three-coordinated in a trigonal planar arrangement.^[2]

Contents

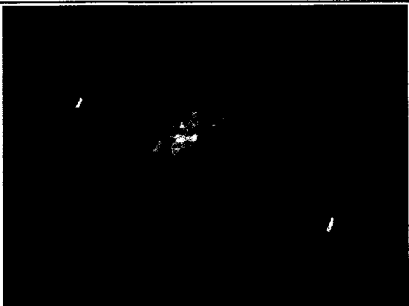


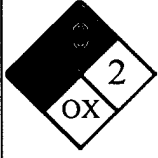
- 1 Preparation
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Preparation

Silver nitrate can be prepared by simply reacting silver, for example a silver bullion or silver foil, with nitric acid. The equation is: $\text{Ag} + 2\text{HNO}_3 \rightarrow \text{AgNO}_3 + \text{NO}_2 + \text{H}_2\text{O}$

This must be performed under a fume hood because of the nitrogen oxides evolved in the reaction.^[3]

Uses

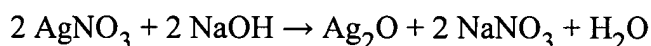
Silver nitrate	
$\text{Ag}^+ \left[\begin{array}{c} \text{O} \\ \parallel \\ \text{O} - \text{N} = \text{O} \end{array} \right]^-$	
	
Other names	Nitric acid silver(1+) salt
Identifiers	
CAS number	7761-88-8 '
ChEBI	32130
Properties	
Molecular formula	AgNO_3
Molar mass	169.87 g mol ^{−1}
Appearance	white solid
Melting point	212 °C, 485 K, 414 °F
Boiling point	444 °C, 717 K, 831 °F (decomp.)
Solubility in water	very soluble
Solubility	soluble in ethanol and acetone
Hazards	
EU classification	<div>  C  N </div>
R-phrases	R8,R34, R50/53
S-phrases	(S1/2), S26, S45, S60, S61
NFPA 704	<div>  </div>
Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa)	

Precursor to other silver compounds

Infobox references

Silver nitrate is the least expensive salt of silver; it offers several other advantages as well. It is non-hygroscopic, in contrast to silver fluoroborate and silver perchlorate. It is relatively stable to light. Finally it dissolves in numerous solvents, including water. The nitrate can be easily replaced by other ligands, rendering AgNO_3 versatile. Treatment with solutions of halide ions gives a precipitate of AgX ($\text{X} = \text{Cl}, \text{Br}, \text{I}$). When making photographic film, silver nitrate is treated with halide salts of sodium or potassium to form insoluble silver halide in situ in photographic gelatin, which is then applied to strips of tri-acetate or polyester. Similarly, silver nitrate is used to prepare some silver-based explosives, such as the fulminate, azide, or acetylide, through a precipitation reaction.

Treatment of silver nitrate with base gives dark grey silver oxide:^[4]



Halide abstraction

The silver cation quickly and effectively irreversibly reacts with halide anions to produce the insoluble silver halide, which is usually a creamy precipitate. This reaction is commonly used in inorganic chemistry to abstract the halide as the insoluble silver salt:



Other silver salts with non-coordinating anions, namely silver tetrafluoroborate and silver hexafluorophosphate are used for more demanding applications.

Similarly, this reaction is used in analytical chemistry to confirm the presence of chloride, bromide, or iodide ions can be tested by adding silver nitrate solution. Samples are typically acidified with dilute nitric acid to remove interfering ions, e.g. carbonate ions and sulfide ions. This step avoids confusion of silver sulfide or silver carbonate precipitates with that of silver halides. The color of precipitate varies with the halide: white (silver chloride), pale yellow/cream (silver bromide), yellow (silver iodide). AgBr and especially AgI photo-decompose to the metal, as evidence by a grayish color on exposed samples.

Organic synthesis

Silver nitrate is used in many ways in organic synthesis, e.g. for deprotection and oxidations. Ag^+ binds alkenes reversibly, and silver nitrate has been used to separate mixtures of alkenes by selective absorption. The resulting adduct can be decomposed with ammonia to release the free alkene.^[5]

Biology

In histology, silver nitrate is used for silver staining, for demonstrating proteins and nucleic acids. For this reason it is also used to demonstrate proteins in PAGE gels. It is also used as a stain in scanning electron microscopy.

Medicine

Silver salts have antiseptic properties. Until the development and widespread adoption of antibiotics, dilute solutions of AgNO_3 used to be dropped into newborn babies' eyes at birth to prevent contraction of gonorrhoea from the mother. Eye infections and blindness of newborns was reduced by this method; incorrect dosage, however, could cause blindness in extreme cases. This protection was first used by Credé in 1881.^{[6][7][8]} Fused silver nitrate, shaped into sticks, was traditionally called "lunar caustic". It is used as a cauterizing agent, for example to remove granulation tissue around a stoma. Dentists sometimes use silver nitrate infused swabs to heal oral ulcers. Silver nitrate is also used by some podiatrists to kill cells located in the nail bed.

The Canadian physician C. A. Douglas Ringrose researched the use of silver nitrate for sterilization procedures on women. A specialist in obstetrics and gynaecology, Ringrose believed that the corrosive properties of silver nitrate could be used to block and corrode the fallopian tubes, in a process that he called "office tubal sterilization".^[9] The technique was ineffective; in fact at least two women underwent abortions. Ringrose was sued for malpractice, although these suits were unsuccessful.^[10]

Disinfection

Much research has been done in evaluating the ability of the silver ion at inactivating *E. coli*, a microorganism commonly used as an indicator for fecal contamination and as a surrogate for pathogens in drinking water treatment. Concentrations of silver nitrate evaluated in inactivation experiments range from 10-200 micrograms per liter as Ag^+ . The antimicrobial properties of silver was first observed thousands of years ago when silver containers were used to store water for preservation. Its disinfection ability has been scientifically studied for over a century.

Applications

The antimicrobial properties of silver have been put to a wide variety of uses, including:

- Water disinfection in hotels and hospitals
- Postharvest cleaning of oysters and crabs
- Inhibition of bacterial growth on chicken farms
- Water recycling aboard space shuttles
- Home purification of water in Europe and North America
- Point of use disinfectant for water and vegetables in Mexico
- Alternative to antibiotics (not recommended by the FDA)
- Alternative to laundry detergent
- Application to eyes of newborn babies to prevent infection
- Coating on catheters to prevent infection^[11]

This property of silver was used for many purposes prior to the discovery of pharmaceutical antibiotics when it fell into near disuse. Its association with argyria made consumers wary and led them to turn away from it when given an alternative. Since that time, as antibiotic-resistant microorganisms have emerged, interest in using the silver ion for anti-microbial purposes has resumed.^[12]

Kinetics

Before a disinfectant can be effectively used as a water disinfectant, its inactivation kinetics must be established. Kinetics generally depend on both the dosage of disinfectant and the time of application. It

is important to understand the kinetics so that the minimum dosage of disinfectant can be applied for the minimum amount of time while still effectively inactivating any pathogens in the water. Because there are many microorganisms present in water, the inactivation kinetics of each one cannot be studied extensively. Therefore, indicator organisms generally more resistant to inactivation than others are used to estimate the kinetics of microorganisms as a whole. *Escherichia coli*, also referred to as *E. coli*, is a commonly used indicator organism.

It is well-documented that the silver ion is effective in the inactivation of *E. coli*.^{[13][14][15][16][17][18][19][20][21][22][23][24]} However, there are many inconsistencies in the literature regarding the kinetics of the inactivation of *E. coli* by the silver ion. With inconsistent data, it is impossible to tell what the true inactivation kinetics are, and therefore impossible to implement any sort of large-scale water treatment.

The inconsistencies may be due to several factors. First, the kinetics may depend on the source of the silver ion being used. In recent years, research has focused largely on electrolytically generated silver ions or colloidal silver. Most studies in which the inactivation kinetics of *E. coli* by silver nitrate were explored extensively date back several decades. Even within this smaller group of studies, vast inconsistencies exist, likely due to inaccurate analytical methods for measuring the concentration of silver in solution.^[25] Monitoring the decay of the silver ion in solution is imperative as silver tends to both adsorb readily to organic matter in the water and to be light reactive.^[26] Furthermore, silver tends to adsorb to glassware, which can lead not only to a decrease in the silver concentration within a given experiment but also to a release of the silver in subsequent experiments unless measures further than general glassware washing are taken for the removal of silver from the glassware surface.^[23] Therefore studies must both minimize the external factors effecting the concentration and to measure the changes in concentration that take place throughout the experiment.

Effects of various parameters

Despite the inconsistencies in the literature regarding the kinetics of the inactivation of *E. coli* by silver nitrate, important information can still be taken from the work. A study by Wuhrmann and Zobrist investigated the effect of various parameters upon the kinetics. First, they studied the effect of several ions in the water, including calcium, phosphates and chloride, all of which were found to decrease the bactericidal effect of silver.^[22] These effects are important to consider when designing an experiment. Because of the effect of phosphates, it is undesirable to use phosphate buffer to run experiments, as this creates a phosphate concentration much higher than that found in natural waters and will falsely slow the inactivation kinetics. Furthermore, it is important to avoid touching any glassware with bare hands, as chloride from sweat may contaminate the glassware, again slowing inactivation. Chambers, Proctor and Kabler established the importance of using an effective neutralizer solution made of a combination of sodium thioglycolate and sodium thiosulfate, rather than sodium thiosulfate alone, which though it is effective in neutralizing other disinfectants does not sufficiently stop the bactericidal action of silver nitrate.^[23] Both tested the effect of pH on the kinetics, finding that a higher pH increased the bactericidal action.^{[23][26]} Wuhrmann and Zobrist further established that at a higher temperature, inactivation occurs faster.^[22]

Kinetic models

A further complication of the inactivation kinetics by silver is the question of which model to use. With most disinfectants, the inactivation is effectively modeled using a first-order Chick-Watson model, which states that a certain level of disinfection will occur at a certain CT, or concentration *time value.^[27] According to this model, the same amount of inactivation should take place when a concentration of

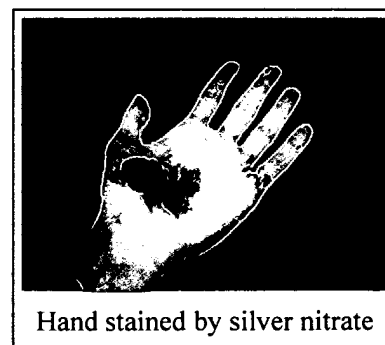
0.2 mg/L is applied for 10 minutes as when 0.02 mg/L is applied for 100 minutes. Wuhrmann and Zobrist found rate kinetics that followed this model for all conditions, which agrees fairly well with a study by Chambers and Proctor, while another study by Renn and Chesney found curves that did not follow this law.^[25] It is therefore unclear whether this law sufficiently models inactivation by the silver ion.

Most recent papers regarding the disinfection of *E. coli* by silver nitrate have simply plotted the level of disinfection against time.^{[13][16][18][20][21]} While this method of data analysis does not risk making false assumptions about first-order kinetics, it does nothing to account for the applied concentration, which is essential to any kinetics. Therefore, different curves need to be generated for each concentration that might be applied. Furthermore, it does not account for changes in concentration that might take place during the experiment, and which may vary based on many factors.

A third model which has been suggested for the inactivation kinetics by silver nitrate is that of $C_s \cdot T$, or chemisorbed silver onto the cell body times time. This model suggests that the rate of inactivation depends not on the concentration in the water at a given time, but rather on the silver that has been chemisorbed by the bacteria. It is assumed, according to this model that $C_0 = C_1 + C_2 + C_3$, where C_0 is the initial concentration, C_1 is the silver still in solution, C_2 is the silver lost to adsorption to glassware or other factors in the solution, and C_3 is the silver chemisorbed to the bacteria. C_0 is measured at the beginning of the experiment, C_1 is measured throughout the experiment, and C_2 is determined in a control experiment without bacteria. C_3 , or the C_s value, is then determined to be $C_0 - C_1 - C_2$.^{[14][28]} According to Hwang, et al., this model was successful in estimating inactivation of *E. coli* by silver nitrate.^[14] Although it is possible that this model does not sufficiently account for all of the possible fates of the initial silver nitrate added to the solution, it is certainly a compelling method of data analysis. Because it is a new model, it has not been extensively studied by various researchers.

Safety

Despite being used in low concentrations to prevent gonorrhea, silver nitrate is toxic and corrosive, as with all silver salts.^[29] Brief exposure to the chemical will not produce immediate or even any side effects other than the purple, brown or black skin stains, but with more exposure, side effects will become more noticeable, including burns. Long-term exposure may cause eye damage. Short contact can lead to deposition of black silver stains on the skin. Besides being very destructive of mucous membranes, it is skin and eye irritant.



Although silver nitrate is currently not regulated in water sources by the Environmental Protection Agency, when between 1-5 g of silver have accumulated in the body, a condition called argyria can develop. Argyria is a permanent cosmetic condition in which the skin and internal organs turn a blue-gray color. The United States Environmental Protection Agency had a maximum contaminant limit for silver in water until 1990, but upon determination that argyria did not impact the function of organs affected, removed the regulation.^[26] Argyria is more often associated with the consumption of colloidal silver solutions than with silver nitrate, especially at the extremely low concentrations present for the disinfection of water. However, it is still important to consider before ingesting any sort of silver-ion solution.

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External links

- International Chemical Safety Card 1116
- NIOSH Pocket Guide to Chemical Hazards

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Categories: Antiseptics | Electron microscopy stains | Nitrates | Photographic chemicals | Silver compounds | Staining dyes | Alchemical substances | Light-sensitive chemicals

Hidden categories: All articles with unsourced statements | Articles with unsourced statements from January 2008 | Wikipedia articles needing rewrite from May 2009

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NFPA 704

EXHIBIT B

From Wikipedia, the free encyclopedia

NFPA 704 is a standard maintained by the U.S.-based National Fire Protection Association. It defines the colloquial "**fire diamond**" used by emergency personnel to quickly and easily identify the risks posed by nearby hazardous materials. This is necessary to help determine what, if any, specialty equipment should be used, procedures followed, or precautions taken during the first moments of an emergency response.



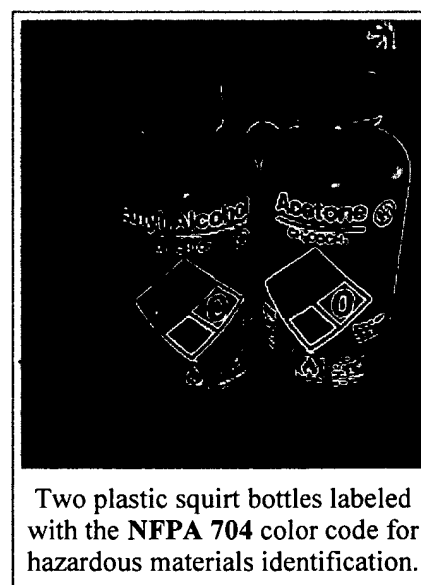
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Symbolism

The four divisions are typically color-coded, with blue indicating level of health hazard, red indicating flammability, yellow (chemical) reactivity, and white containing special codes for unique hazards. Each of health, flammability and reactivity is rated on a scale from 0 (no hazard; normal substance) to 4 (severe risk).

Health (blue)	
4	Very short exposure could cause death or major residual injury (e.g., hydrogen cyanide, phosphine)
3	Short exposure could cause serious temporary or moderate residual injury (e.g., chlorine gas)
2	Intense or continued but not chronic exposure could cause temporary incapacitation or possible residual injury (e.g., ethyl ether)
1	Exposure would cause irritation with only minor residual injury (e.g., Acetone)
0	Poses no health hazard, no precautions necessary. (e.g., lanolin)



Flammability (red)	
4	Will rapidly or completely vaporize at normal atmospheric pressure and temperature, or is readily dispersed in air and will burn readily (e.g., propane). Flash point below 23°C (73°F)
	Liquids and solids that can be ignited under almost all ambient temperature conditions (e.g.,

3	gasoline). Flash point between 23°C (73°F) and 38°C (100°F)
2	Must be moderately heated or exposed to relatively high ambient temperature before ignition can occur (e.g., diesel fuel). Flash point between 38°C (100°F) and 93°C (200°F)
1	Must be heated before ignition can occur (e.g., soybean oil). Flash point over 93°C (200°F)
0	Will not burn (e.g., water)

Instability/Reactivity (yellow)	
4	Readily capable of detonation or explosive decomposition at normal temperatures and pressures (e.g., nitroglycerine, RDX)
3	Capable of detonation or explosive decomposition but requires a strong initiating source, must be heated under confinement before initiation, reacts explosively with water, or will detonate if severely shocked (e.g. ammonium nitrate)
2	Undergoes violent chemical change at elevated temperatures and pressures, reacts violently with water, or may form explosive mixtures with water (e.g., phosphorus, potassium, sodium)
1	Normally stable, but can become unstable at elevated temperatures and pressures (e.g. hydrogen peroxide)
0	Normally stable, even under fire exposure conditions, and is not reactive with water (e.g. helium)

White - Special

The white "special notice" area can contain several symbols. The following symbols are defined by the NFPA 704 standard:

- **W**: reacts with Water in an unusual or dangerous manner (e.g., caesium, sodium)
- **OX** or **OXY**: Oxidizer (e.g., potassium perchlorate, ammonium nitrate, hydrogen peroxide)
- **SA**: Simple asphyxiant gas (includes nitrogen, helium, neon, argon, krypton, or xenon)

Non-standard symbols

Note: These symbols are not part of the NFPA 704 standard, but occasionally used in an unofficial manner. The use of non-standard symbols or text may be permitted, required or disallowed by the authority having jurisdiction (e.g., fire department).

- **COR**: Corrosive; strong acid or base (e.g. sulfuric acid, potassium hydroxide)
 - **ACID** and **ALK** to be more specific.
- **BIO**: Biological hazard (e.g., smallpox virus)
- **POI**: Poisonous (e.g. Spider Venom),
- **☢** (the Radioactive trefoil): is radioactive (e.g., plutonium, uranium)
- **CRY** or **CRYO**: Cryogenic (e.g. Liquid Nitrogen)

See also

- Hazard symbol

- HMIS Color Bar
- Hazchem
- Hazmat

References

- 1910.1200 Hazard communication
- University of Oregon Chem Labs - NFPA Hazard Identification System

External links

- List of NFPA Ratings for many chemicals
- About NFPA 704: Standard for the Identification of Hazards of Materials for Emergency Response
- NFPA 704 Diamond Rating Explanation Guide

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